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IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
AKIRA TAMATANI, ET AL.	: EXAMINER: DI GRAZIO, J.
SERIAL NO: 09/803,103	:
FILED: MARCH 12, 2001	: GROUP ART UNIT: 2871
FOR: LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR MANUFACTURING THE SAME	:

APPEAL BRIEF

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

This is an appeal of the Final Rejection dated October 8, 2003 of Claims 1-24. A Notice of Appeal, with a two-month extension of time, is **submitted herewith**.

I. REAL PARTY IN INTEREST

The real party in interest in this appeal is Advanced Display, Inc. having an address 997, Miyoshi, Nishigoshi-Machi, Kikuchi-Gun, Kumamoto, Japan 861-1198.

II. RELATED APPEALS AND INTERFERENCES

Appellants, Appellants' legal representative and the assignee are aware of no appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF THE CLAIMS

Claims 1-24, all the claims in the application, stand rejected and are herein appealed.

IV. STATUS OF THE AMENDMENTS

An Amendment under 37 CFR 1.116 was timely filed on December 30, 2003. In an Advisory Action entered February 13, 2004, the Examiner indicated that upon the filing of an appeal, the amendment will be entered. A Supplemental Amendment under 37 CFR 1.116 is **submitted herewith**, which corrects a typographical error in Claim 24.

The attached Appendix I reflects Claims 1-24 as amended by the above-referenced Amendment under 37 CFR 1.116 and Supplemental Amendment under 37 CFR 1.116.

V. SUMMARY OF THE INVENTION

The present invention relates to a liquid crystal display device and a method for manufacturing the same wherein the device employs columnar spacers (projections) for maintaining a gap into which liquid crystal is injected constant.

As described in the specification beginning at page 1, line 6, processes for making liquid crystal display devices employing such projections have been problematical, and solutions to such problems have been suggested, but they are also problematical.

Applicants successfully address problems of the prior art with the present invention, which is described in the specification as comprising three different embodiments.

In Embodiment 1, and as reflected in, for example, Claim 1, "an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than

0.001 and not more than 0.003." See also the specification at page 8, line 18 through page 13, line 14.

Embodiment 2 relates to a pressurized sealing process, meaning that the liquid crystal display device undergoes a pressurizing process simultaneously with sealing the liquid crystal injection inlet with a sealing agent, as described in the specification at page 13, line 16 through page 17, line 2. In this embodiment, the pressure is not less than 20,000 Pa and not more than 40,000 Pa, as reflected in, for example, Claim 8. An alternative or complementary embodiment of Embodiment 2 involves time elapsed from completion of injecting liquid crystal up to sealing the injection inlet. This aspect is reflected in, for example, Claim 10. Preferred is a specified time of not less than 30 minutes and not more than 60 minutes, as reflected in Claim 11.

In Embodiment 3, spacers of different height are disposed, as reflected in, for example, Claim 5, and as described in the specification at page 17, lines 4-25. Preferred height differences are recited in, for example, Claims 6 and 7.

VI. ISSUES

(A) Whether Claims 1-4 are unpatentable under 35 U.S.C. §103(a) over U.S. 5,978,061 (Miyazaki et al)?

(B) Whether Claims 5-7 and 14-17 are unpatentable under 35 U.S.C. § 103(a) over Miyazaki et al in view of U.S. 6,525,799 (Fukuda)?

(C) Whether Claims 8, 10-11 and 19-20 are unpatentable under 35 U.S.C. § 103(a) over JP10-104642 (Miyazaki Ryuji) in view of U.S. 6,275,280 (Kajita et al)?

(D) Whether Claim 9 is unpatentable under 35 U.S.C. § 103(a) over Miyazaki Ryuji in view of Kajita et al, and further in view of JP59-078320 (Ogura Makoto)?

(E) Whether Claims 12, 13, 21 and 22 are unpatentable under 35 U.S.C. § 103(a) over Miyazaki Ryuji in view of Miyazaki et al and further in view of Kajita et al?

(F) Whether Claims 23 and 24 are unpatentable under 35 U.S.C. § 103(a) over Miyazaki Ryuji in view of Fukuda, and further in view of Miyazaki et al and further in view of Kajita et al?

(G) Whether Claim 18 is unpatentable under 35 U.S.C. § 103(a) over Miyazaki Ryuji in view of Kajita et al, and further in view of Ogura Makoto?

VII. GROUPING OF THE CLAIMS

The claims all stand or fall separately.

VIII. ARGUMENT

Introduction that applies to all Issues

The present invention relates to a liquid crystal display device and a method for manufacturing the same wherein the device employs columnar spacers (projections) for maintaining a gap into which liquid crystal is injected constant.

As described in the specification beginning at page 1, line 6, processes for making liquid crystal display devices employing such projections have been problematical, and solutions to such problems have been suggested, but they are also problematical.

Applicants successfully address problems of the prior art with the present invention, which is described in the specification as comprising three different embodiments.

In Embodiment 1, and as reflected in, for example, Claim 1, "an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than 0.001 and not more than 0.003." See also the specification at page 8, line 18 through page 13, line 14.

Embodiment 2 relates to a pressurized sealing process, meaning that the liquid crystal display device undergoes a pressurizing process simultaneously with sealing the liquid crystal injection inlet with a sealing agent, as described in the specification at page 13, line 16 through page 17, line 2. In this embodiment, the pressure is not less than 20,000 Pa and not more than 40,000 Pa, as reflected in, for example, Claim 8. An alternative or complementary embodiment of Embodiment 2 involves time elapsed from completion of injecting liquid crystal up to sealing the injection inlet. This aspect is reflected in, for example, Claim 10. Preferred is a specified time of not less than 30 minutes and not more than 60 minutes, as reflected in Claim 11.

In Embodiment 3, spacers of different height are disposed, as reflected in, for example, Claim 5, and as described in the specification at page 17, lines 4-25. Preferred height differences are recited in, for example, Claims 6 and 7.

The significance of the limitations of above-discussed Embodiments 1-3 is reflected in the comparative data of record, i.e., Examples 1-13, as described in the specification at page 18, lines 2-6.

Examples 1-4 relate to Embodiment 1. Examples 1 and 2 are according to the invention. Example 3, with an area occupying ratio of 0.0048, and Example 4, with an area occupying ratio of 0.0059, are outside the terms of the present claims. According to the high temperature test described in the specification at page 18, last paragraph, no or hardly any

display blurs were observed for Examples 1 and 2, while some or remarkable display blurs were observed in Examples 3 and 4. In addition, bubbles were generated in the low temperature test, described in the specification at page 18, last paragraph, in Example 4.

Examples 5-7 relate to Embodiment 2, wherein the only variable was pressure at the time of applying the sealing agent. Example 5 employed no pressure; Example 6 employed a pressure of 20,000 Pa; and Example 7 employed a pressure of 49,000 Pa. Example 5 produced display blurs were observed during the high temperature test. Example 7 produced bubbles during the low temperature test. In Example 6, the only example within the terms of the present invention, neither blurs nor bubbles were observed.

The above-discussed alternative or complementary embodiment of Embodiment 2 is demonstrated in Examples 8-11, wherein the only variable was time elapsed from completion of injecting liquid crystal up to sealing the injection inlet. Example 8, wherein the time elapsed was 0 minutes, and Example 11, wherein the time elapsed was 120 minutes, were both outside the terms of present Claim 11; bubbles were generated during the low temperature test and display blurs during the high temperature test, respectively. On the other hand, and within the terms of Claim 11, Example 9, which employed an elapsed time of 30 minutes, and Example 10, which employed an elapsed time of 60 minutes, both resulted in neither display blurs nor bubbles.

Embodiment 3 is demonstrated by Examples 12 and 13. In Example 12, the height of the columnar spacers were 3.4 μm and 3.6 μm, and are thus according to Embodiment 3. In Example 13, the heights were the same, and are thus outside the terms of Embodiment 3. In Example 12, no display blurs were observed. In Example 13, slight display blurs were observed during the high temperature test.

Applicants describe the results from the above-discussed comparative data, in the specification at page 25, line 26, through the end of page 26, as follows:

> As explained so far, according to the first aspect of the present invention [i.e., Embodiment 1], it is possible to obtain a liquid crystal display device free of display blurs at the time of using the same in a high temperature condition and with which no bubbles are generated when using the same in a low temperature condition by setting the area occupying ratio for the columnar spacers to be an optimal value.
>
> According to the second aspect of the present invention [i.e., Embodiment 3], it is possible to further secure an amount of compressive deformation for the columnar spacers since heights of columnar spacers are varied, and thereby to obtain a liquid crystal display device free of display blurs at the time of using the same in a high temperature condition and with which no bubbles are generated when using the same in a low temperature condition.
>
> According to the third aspect of the present invention [i.e., Embodiment 2], it is possible to obtain a liquid crystal display device in which display blurs at the time of using the same in a high temperature condition might be restricted by performing a pressurized sealing process.
>
> According to the fourth aspect of the present invention [i.e., alternative or complementary embodiment of Embodiment 2], it is possible to obtain a liquid crystal display device free of display blurs at the time of using the same in a high temperature condition and with which no bubbles are generated when using the same in a low temperature condition by the arrangement of sealing the injection inlet of the liquid crystal display device by means of a sealing agent after a specified time has elapsed after completion of injecting liquid crystals.

Issue (A)

The rejection of Claims 1-4 under 35 U.S.C. § 103(a) as unpatentable over U.S. 5,978,061 (Miyazaki et al), is respectfully traversed. Miyazaki et al discloses a liquid crystal display device wherein "[f]or actualizing the substrate-to-substrate distance of approximately 1-10 (μm) that the normal liquid crystal display device needs to have, it is required that a sum of sectional areas of the surfaces of the spacers, parallel to the substrates, which occupy per a

square millimeter, should exceed 0.00002 square millimeter, but be less than 0.005 square millimeter" (column 19, lines 44-50). The above description is with regard to a twelfth and thirteenth embodiment of Miyazaki et al (column 19, line 27 ff). Miyazaki et al exemplifies the twelfth and thirteenth embodiment with a sum of sectional areas of 0.0009 square millimeter (column 20, line 24). In a fourteenth embodiment, Miyazaki et al exemplifies a sum of sectional areas of 0.0007 square millimeter (column 21, line 63). Miyazaki et al thus exemplifies no sum of sectional areas within the presently-recited range of, for example, Claim 1, but exemplifies a number of sum of sectional area values below the presently-recited minimum of 0.001. In addition, above-discussed Example 3, which is within the range disclosed in Miyazaki et al, nevertheless, is shown to be inferior to the invention as claimed herein. In effect, Applicants have demonstrated unexpected results relative to the range disclosed in Miyazaki et al who, in effect, suggests equivalents for all values within their disclosed range. See *In re Woodruff*, 16 USPQ 2d 1934 (Fed. Cir. 1990).

In view of the statutory requirement that the invention as a whole be considered, the Examiner may not ignore this evidence.

Claim 2 is separately patentable since Miyazaki et al neither disclose nor suggest the liquid crystal display device of Claim 1, wherein the area occupying ratio is not less than 0.001 and not more than 0.002. Miyazaki et al exemplifies no sum of sectional areas within the presently-recited range, but exemplifies a number of sum of sectional area values below the presently-recited minimum of 0.001.

Claim 3 is separately patentable since Miyazaki et al neither disclose nor suggest the liquid crystal display device of Claim 1, wherein the area occupying ratio is not less than 0.001 and not more than 0.0015. Miyazaki et al exemplifies no sum of sectional areas within

the presently-recited range, but exemplifies a number of sum of sectional area values below the presently-recited minimum of 0.001.

Claim 4 is separately patentable since Miyazaki et al neither disclose nor suggest the liquid crystal display device of any one of Claims 1-3, wherein the film is formed of acrylic resin. Miyazaki et al's disclosure of an acrylic resin is with regard to an ultraviolet ray hardening resist (column 8, line 4ff). It is not clear that Miyazaki et al's pillar-shaped spacer 33 is formed of acrylic resin.

Issue (B)

The rejection of Claims 5-7 and 14-17 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki et al in view of Fukuda is respectfully traversed. The disclosures and deficiencies of Miyazaki et al have been discussed above. Fukuda does not remedy these deficiencies.

As to Claims 5 and 14, the Examiner relies on Fukuda as disclosing that the peak height of spacers is in the range of 0.05 to 0.50 μm. The Examiner, however, incorrectly relies on this disclosure as disclosing or suggesting a difference in heights of respective spacers therein. Rather, with respect to this range of peak heights, Fukuda discloses that there seems to be an optimum range in the peak height (column 5, lines 24-25). Thus, Fukuda suggests, in effect, that all of the spacers have the optimum peak height. In other words, Fukuda neither discloses nor suggests variance in height of individual spacers.

Claim 14 is separately patentable over Claim 5, since the combination of Miyazaki et al and Fukuda neither discloses nor suggests a liquid crystal device of a transverse field method.

Claims 6 and 15 are separately patentable since the combination of Miyazaki et al and Fukuda neither disclose nor suggest the liquid crystal display device of Claim 5 or Claim 14, respectively, wherein the heights are different by not less than 0.05 μm. As stated above, Fukuda suggests, in effect, that all of the spacers have the optimum peak height, i.e., they all have the same height.

Claim 15 is separately patentable over Claim 6, since the combination of Miyazaki et al and Fukuda neither discloses nor suggests a liquid crystal device of a transverse field method.

Claims 7 and 16 are separately patentable since the combination of Miyazaki et al and Fukuda neither disclose nor suggest the liquid crystal display device of Claim 5 or Claim 14, respectively, wherein the heights are different by not less than 0.05 μm and not more than 0.2 μm. As stated above, Fukuda suggests, in effect, that all of the spacers have the optimum peak height, i.e., they all have the same height.

Claim 16 is separately patentable over Claim 7, since the combination of Miyazaki et al and Fukuda neither discloses nor suggests a liquid crystal device of a transverse field method.

Claim 17 is separately patentable since the combination of Miyazaki et al and Fukuda neither disclose nor suggest a liquid crystal display device of a transverse field method comprising: a sealing material provided on a periphery of a substrate for preventing leakage of liquid crystal, projections formed by etching a film formed on the substrate, and another substrate opposing the substrate being remote therefrom by a gap and being supported by the projections, wherein an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than 0.0014 and not more than 0.0029, and height

of projections are varied by not less than 0.05 μm and not more than 0.2 μm. Miyazaki et al exemplifies no sum of sectional areas within the presently-recited range, but exemplifies a number of sum of sectional area values below the presently-recited minimum of 0.0014, and as stated above, Fukuda suggests, in effect, that all of the spacers have the optimum peak height, i.e., they all have the same height.

Issue (C)

The rejection of Claims 8, 10-11 and 19-20 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki Ryuji in view of Kajita et al, is respectfully traversed. Miyazaki Ryuji discloses preparing a liquid crystal panel by applying a sealing resin near a liquid crystal injection port while maintaining a liquid crystal extruding pressure, then dropping the pressure down to a resin withdrawing pressure, which according to Miyazaki Ryuji, obviates the occurrence of a sealing error, has excellent uniformity of the gap between substrates and is strong to an external press without the occurrence of display unevenness. Kajita et al discloses application of a pressure of about 10,000 to 100,000 Pa to the substrates while sticking them together to produce a liquid crystal display device (column 3, lines 57-61).

However, as to Claims 10 and 19, neither Miyazaki Ryuji nor Kajita et al disclose the time of application of pressure. Thus, it is not clear at what step this pressure is applied, and it is not clear that this step coincides with the step in Miyazaki Ryuji. Even if it did, note that the application of pressure of Claim 8 is in reference to a pressurized sealing process in which the liquid crystal display device undergoes a pressurizing process simultaneous with sealing the liquid crystal injection inlet with a sealing agent, as described in the specification at page 14, lines 21-27. Nevertheless, even if Miyazaki Ryuji and Kajita et al were both drawn to

such a pressurized sealing process, the above-discussed comparative data of record demonstrates the significance of the presently-recited range of 20,000-40,000 Pa. Indeed, Example 7, which is within the range of Kajita et al, but outside the presently-recited range, results in bubbles during the low temperature test. Under *Woodruff, supra*, the present claims are patentable for this reason also.

Claim 19 is separately patentable over Claim 10, since, while Kajita et al refers to an in-plate switching mode (IPS) system, which may be construed as the same as a transverse field method, Kajita et al does not describe the control of a gap (distance between substrates) of a liquid crystal device.

Claims 11 and 20 are separately patentable since the combination of Miyazaki Ryuji and Kajita et al neither disclose nor suggest the method of Claim 10 or Claim 19, respectively, wherein the specified time is not less than 30 minutes and not more than 60 minutes. Indeed, as discussed above, neither Miyazaki Ryuji nor Kajita et al disclose the time of application of pressure.

Claim 20 is separately patentable over Claim 11, since, while Kajita et al refers to an in-plate switching mode (IPS) system, which may be construed as the same as a transverse field method, Kajita et al does not describe the control of a gap (distance between substrates) of a liquid crystal device.

Issue (D)

The rejection of Claim 9 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki Ryuji in view of Kajita et al, and further in view of JP59-078320 (Ogura Makoto), is respectfully traversed. The disclosures and deficiencies of Miyazaki Ryuji and Kajita et al

have been discussed above. Ogura Makoto does not remedy these deficiencies. Ogura Makoto discloses sealing the injection opening of a liquid crystal cell with a sealing material. However, this disclosure does not remedy the above-discussed deficiencies in the combination of Miyazaki Ryuji and Kajita et al.

Issue (E)

The rejection of Claims 12, 13, 21 and 22 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki Ryuji in view of Miyazaki et al and further in view of Kajita et al, is respectfully traversed.

The disclosures and deficiencies of all of the above-applied references have been discussed above. Nothing in their combination remedies any of the above-discussed deficiencies.

Thus, for Claims 12 and 21, none of the applied prior art, alone or in any combination, discloses or suggests an area occupying ratio of not less than 0.001 and not more than 0.003, or applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates, especially in view of the above-discussed comparative data in support thereof.

Claim 21 is separately patentable over Claim 12, since, while Kajita et al refers to an in-plate switching mode (IPS) system, which may be construed as the same as a transverse field method, Kajita et al does not describe the control of a gap (distance between substrates) of a liquid crystal device.

For Claims 13 and 22, none of the applied prior art, alone or in any combination, discloses or suggests an area occupying ratio of not less than 0.001 and not more than 0.003,

or applying a a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal.

Claim 22 is separately patentable over Claim 13, since, while Kajita et al refers to an in-plate switching mode (IPS) system, which may be construed as the same as a transverse field method, Kajita et al does not describe the control of a gap (distance between substrates) of a liquid crystal device.

Issue (F)

The rejection of Claims 23 and 24 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki Ryuji in view of Fukuda, and further in view of Miyazaki et al and further in view of Kajita et al, is respectfully traversed. The disclosures and deficiencies of all of the above-applied references have been discussed above. Nothing in their combination remedies any of the above-discussed deficiencies.

Thus, for Claim 23, none of the applied prior art, alone or in any combination, discloses or suggests heights of projections being varied by not less than 0.05 μm and not more than 0.2 μm; an area occupying ratio of not less than 0.0014 and not more than 0.0029; or applying a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal.

For Claim 24, none of the applied prior art, alone or in any combination, discloses or suggests heights of projections being varied by not less than 0.05 μm and not more than 0.2 μm; an area occupying ratio of not less than 0.0014 and not more than 0.0029; or applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates, especially in view of the above-discussed comparative data in support thereof.

Issue (G)

The rejection of Claim 18 under 35 U.S.C. § 103(a) as unpatentable over Miyazaki Ryuji in view of Kajita et al, and further in view of Ogura Makoto, is respectfully traversed. The reasons of traversal are identical to those for the rejection of Claim 9 over the same combination of references.

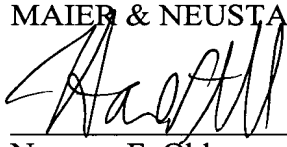
For all the above reasons, it is respectfully requested that the above rejections be REVERSED.

IX. CONCLUSION

For the above reasons, it is respectfully requested that all the rejections still pending in the Final Office Action be REVERSED.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



Norman F. Oblon
Attorney of Record
Registration No. 24,618

Harris A. Pitlick
Registration No. 38,779

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
NFO/HAP/cja

APPENDIX

CLAIMS ON APPEAL

Claim 1. A liquid crystal display device comprising: a sealing material provided on a periphery of a substrate for preventing leakage of liquid crystal, projections formed by etching a film formed on the substrate, and another substrate opposing the substrate being remote therefrom by a gap and being supported by the projections, wherein an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than 0.001 and not more than 0.003.

Claim 2. The liquid crystal display device of Claim 1, wherein the area occupying ratio is not less than 0.001 and not more than 0.002.

Claim 3. The liquid crystal display device of Claim 1, wherein the area occupying ratio is not less than 0.001 and not more than 0.0015.

Claim 4. The liquid crystal display device of any one of Claims 1-3, wherein the film is formed of acrylic resin.

Claim 5. The liquid crystal display device of Claim 1, wherein heights of projections are varied.

Claim 6. The liquid crystal display device of Claim 5, wherein the heights are different by not less than 0.05 μm.

Claim 7. The liquid crystal display device of Claim 5, wherein the heights are different by not less than 0.05 μm and not more than 0.2 μm.

Claim 8. A method for manufacturing liquid crystal display device comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal though the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates.

Claim 9. The method of claim 8, wherein a sealing agent is applied to the liquid crystal injection inlet simultaneously with applying pressure to the surfaces of both substrates.

Claim 10. A method for manufacturing a liquid crystal display device comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal.

Claim 11. The method of Claim 10, wherein the specified time is not less than 30 minutes and not more than 60 minutes.

Claim 12. A method for manufacturing liquid crystal display device comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.001 and not more than 0.003; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates.

Claim 13. A method for manufacturing a liquid crystal display device comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.001 and not more than 0.003; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the seal agent; and applying a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal.

Claim 14. A liquid crystal display device of a transverse field method comprising: a sealing material provided on a periphery of a substrate for preventing leakage of liquid crystal, projections formed by etching a film formed on the substrate, and another substrate opposing the substrate being remote therefrom by a gap and being supported by the projections, wherein an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than 0.001 and not more than 0.003, and heights of projections are varied.

Claim 15. The liquid crystal display device of Claim 14, wherein the heights are different by not less than 0.05 μm.

Claim 16. The liquid crystal display device of Claim 14, wherein the heights are different by not less than 0.05 μm and not more than 0.2 μm.

Claim 17. A liquid crystal display device of a transverse field method comprising: a sealing material provided on a periphery of a substrate for preventing leakage of liquid crystal, projections formed by etching a film formed on the substrate, and another substrate opposing the substrate being remote therefrom by a gap and being supported by the projections, wherein an area occupying ratio of the projections with respect to a region enclosed by the sealing material is not less than 0.0014 and not more than 0.0029, and height of projections are varied by not less than 0.05 μm and not more than 0.2 μm.

Claim 18. A method for manufacturing liquid crystal display device of a transverse field method comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an

injection inlet for liquid crystal; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates, wherein a sealing agent is applied to the liquid crystal injection inlet simultaneously with applying pressure to surfaces of both substrates.

Claim 19. A method for manufacturing a liquid crystal display device of a transverse field method comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal.

Claim 20. The method of Claim 19, wherein the specified time is not less than 30 minutes and not more than 60 minutes.

Claim 21. A method for manufacturing liquid crystal display device of a transverse field method comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.001 and not more than 0.003; overlapping another substrate onto the substrate with the projections and the

sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates.

Claim 22. A method for manufacturing a liquid crystal display device of a transverse field method comprising: forming projections by etching a film formed on a substrate; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.001 and not more than 0.003; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the seal agent; and applying a sealing agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal, the specified time being not less than 30 minutes and not more than 60 minutes.

Claim 23. A method for manufacturing a liquid crystal display of a transverse field method device comprising: forming projections by etching a film formed on a substrate, heights of projections being varied by not less than 0.05 μm and not more than 0.2 μm; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.0014 and not more than 0.0029; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a sealing

agent to the injection inlet of the liquid crystal display device after elapse of a specified time from completion of injecting liquid crystal, the specified time being not less than 30 minutes and not more than 60 minutes.

Claim 24. A method for manufacturing liquid crystal display device of a transverse field method comprising: forming projections by etching a film formed on a substrate, heights of projections being varied by not less than 0.05 μm and not more than 0.2 μm; applying a sealing material on a periphery of the substrate in an annular form except for an injection inlet for liquid crystal, an area occupying ratio of the projections with respect to a region enclosed by the sealing material being designed to be not less than 0.0014 and not more than 0.0029; overlapping another substrate onto the substrate with the projections and the sealing material being interposed therebetween; injecting liquid crystal through the liquid crystal injection inlet into a region enclosed by the sealing material; and applying a pressure of not less than 20,000 Pa and not more than 40,000 Pa to surfaces of both substrates.